COMPUTER FUNDAMENTALS

1.   Introduction to Computers

1.1   Introduction

A computer is a machine which is being used in almost all spheres of life of every human being. Due to advancements in development of computer machines, the computer has become pervasive and is being used in all areas of our lives. With regular research and developments going on it is sure that we will continue to experience new things as time passes.

Personal Computers are being used by the students, engineers, creative writers for calculations, designing and publishing purposes. Computers have also enhanced the learning processes. A student can learn his/her lesson not only in the classroom but also while travelling, or by sitting at
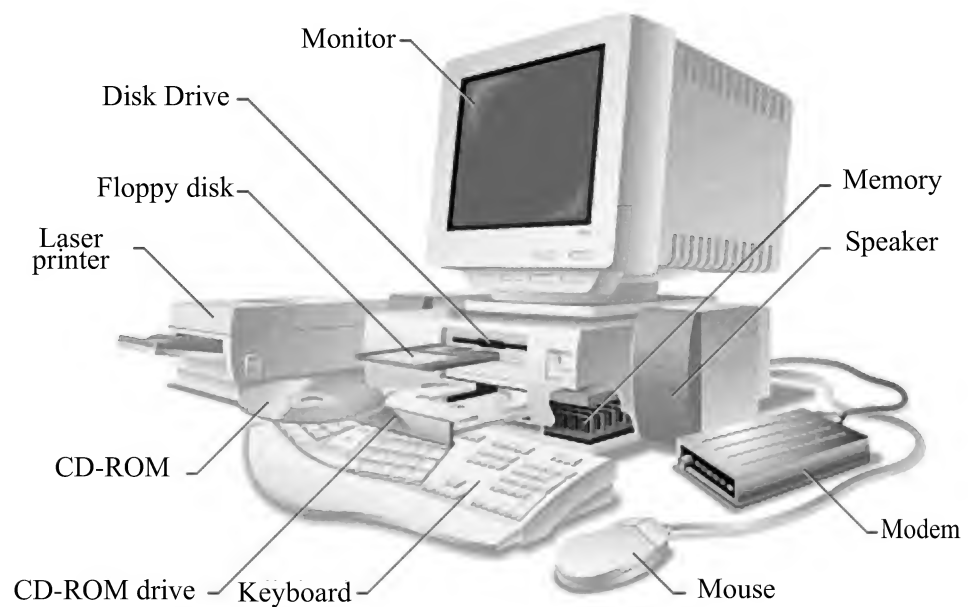
Figure: 1.1 Personal Computer

home with a PC. The internet technology made it possible to bring all the information on the doorsteps of every individual. People are now using computers for enquiries, banking, shopping and many more purposes. We are now passing through an era of information superhighway where all types of information are available just by clicking a button of the computer.

1.2   Computer Generations

We may broadly divide the computer generations into five major periods. Each of these generations may be characterized by the technology it used and the nature of operation of computer systems of that period. With the passage of time new technological innovations took place and the efficiency of computer increased and the cost of processing decreased.

Generation	Device	Hardware feature	Characteristics	System Names
First (1942-1956)		▶ Vacuum Tubes ▶ Punch Cards	▶ Support machine laguage only ▶ Very costly ▶ Generate lot of heat ▶ Hhuge size ▶ Consumed lot of electricity	▶ ENIAC ▶ EDVAC ▶ TBM 701
Second (1956-1965)		▶ Transistors ▶ Magnetic Tapes	▶ Batch operating system ▶ Faster, smaller and reliable than previous generation ▶ Costly	▶ Honeywell 400 ▶ CDC 1604 ▶ IBM 7030
Third (1965-1975)		▶ ICs ▶ Large capacity disk and Magnetic Tapes	▶ Time Sharing OS ▶ Faster, smaller and reliable cheaper ▶ Easier to update	▶ IBM 360/370 ▶ CDC 6600 ▶ PDP 8/11
Fourth (1975-1988)		▶ Ics with VLSI Technology ▶ Semiconductor Memory ▶ Magnetic tapes and floppy as portable	▶ Multiprocessing & GUI OS ▶ Object oriented programs ▶ Small, affordable, easy to use ▶ Easier to update	▶ Apple II ▶ VAX 9000 ▶ CRAY 1/2
Fifth (1988-Present)		▶ Ics with ULSI Technology ▶ Large capacity hard disk with RAID Support ▶ Optical disks as portable read-only storage media ▶ powerful servers, internet Cluster computing	▶ Powerful, cheaper, reliable easy to use, portable ▶ Rapid software development possible	▶ IBM ▶ Pentium ▶ PARAM

Figure: 1.2 Computer Generations

1.2.1   First Generation (1942-1956)

The first generation computers were using vacuum tubes as the main electronic component and used magnetic drums for storing data. Their size was quite big; even they occupied a full room. They were very expensive, heat producing, required a lot of cooling and their maintenance was also very tedious task.

Figure 1.3: EDVAC

The first generation computer operated upon machine language and used it as programming language. Input was given to them by punched cards and paper tapes. They were able to solve one problem at a time.

1.2.2 Second Generation (1956-1965)

The second generation computers used transistors as the electronic component. The transistors made the computers much smaller consumed less power, faster, efficient and were cheaper and reliable than the first generation computers. Although they were heat producing but

Figure 1.4: Vacuum Tubes

Glass Envelope
Plate(anode)
Filament (cathode)
Grid

were more reliable. In this generation, magnetic cores were used as primary memory and magnetic tapes and magnetic disks were used as secondary storage devices. High level languages such as COBOL and FORTRAN were introduced in this generation.

Figure 1.5: Second Generation (CDC 1604)
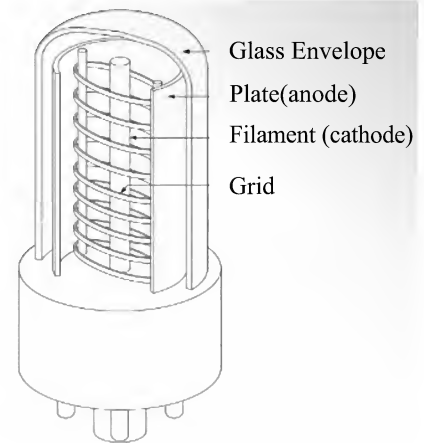
1.2.3 Third Generation (1965 – 1975)

The third generation computers have used Integrated Circuits (I.C.s) in place of transistors. A single IC could hold a large number of transistors, resistors and capacitors which caused the size of the computers more compact. The computers of this generation used keyboards and monitors for input and output respectively. The concept of operating system was also introduced. In this generation, the concept of time sharing and multi programming operating system was introduced. Many new high level languages like FORTRAN IV, PASCAL, and BASIC etc. were introduced in this generation.

Figure 1.6: Third Generation Computers

1.2.4 Fourth Generation (1975-1988)

In this generation, microprocessors were introduced as thousands of ICs were fabricated on a single chip made up of silicon. The computers of this generation used Very Large Scale Integrated Circuits (VLSI) technology. The Intel 4004 chip, which was developed in 1971, located all the

components of a computer on a single chip. The size of the computers reduced which gave rise to the new name desktop computer or personal computer. In this generation, the concept of time sharing, real time processing, distributed operating system was used. New high level languages like C, C++, and Databases were used in this generation.

Figure1.7: PDP 11/70

1.2.5 Fifth Generation (1988 onwards)

In the fifth generation, a new technology ULSI (Ultra Large Scale Integration) was developed resulting in a microprocessor chip on which up to 10 million electronic components could be incorporated. The concepts like artificial intelligence, voice recognition, mobile communication, satellite communication, signal data processing were introduced. Even machines like human brains were developed and more and more work is still going on these new innovations. High level languages like Java, VB and .net framework were introduced in this generation.

1.3 Development of Electronics Machines

Figure 1.8: Abacus

The Abacus, which emerged about 5000 years ago, may be considered as first computer. This device allowed users to perform basic calculations by using a system of sliding beads arranged on a rack. But as the use of paper and pencil spread, the Abacus lost its importance. It took nearly 12 centuries for the next significant advancement in the making of a computing device. In the year 1642, Blaise Pascal, invented a numerical wheel calculator. This brass rectangular box used eight movable dials to add sum up to 8 figures long. He gave it the name 'Pascaline'.

In the year 1646, a German mathematician, Gotfried Wilhem Von Leibniz improved the Pascaline by creating a machine that could also multiply. Leibniz mechanical multiplier worked by a system of gears and dials. This machine was used till 1820, and then the mechanical calculators were introduced by a Frenchman Charles Xavier Thomas De Colmar which was capable of performing four basic arithmetic functions. It was named arithometer. With its enhanced versatility, the

arithometer was widely used up until First World War. The real beginning of computers which we know today can be associated with an English Mathematics Professor Charles Babbage. Babbage attempt brought a new machine which was able to perform differential equations and he named it as Difference Engine. This machine was powered by steam, was quite big in size and was able to store programs and could able to perform calculations and print the result simultaneously. After working on the difference engine for ten years, Babbage inspired to work on first general purpose computer and named it Analytical Engine. Babbage's assistant Augusta Ada King, was instrumental in the machine's design. In their honour, the US defense department named a programming language ADA in her honour in 1980's.

The analytical engine designed by Charles Babbage is quite primitive when compared with today's standards. However, it outlined the basic elements of modern general purpose computer. The analytical engine was consisting of over 50,000 components; the basic input design was in the form of perforated cards, it also contained a 'mill' with a control unit which allowed processing of instructions in any sequence. The output devices were there to produce printed results.

Figure1.9: Analytical Engine

In the year 1889, an American inventor, Herman Hollerith used the Jacquard loom concept to computing. He wanted to find a faster way to compute US census. Hollerith's method used cards to store data information which he fed into the machine and compiled the results mechanically. Hollerith brought this punched card reader into business world, which ultimately gave rose to IBM in 1924. Other companies also entered in the market and manufactured punch readers for business use, both government and business companies used punched cards for data processing until the year 1960. Further, many other scientists and engineers made significant advances in the field of computers. Vannever Bush in the year 1930 developed a mechanically operated device, known a differential analyzer, which was the first general purpose Analog computer. John Atanasoff and Berry constructed the first electronic digital computing device in the year 1939 and its full design was completed in 1942, this computer was designed on the theory of electronics and on the concept of on and off. During the World War II, the Colossus was developed for British Code Breakers; it was the first electronic digital computer. In the year 1946, the first multi-purpose electronic digital computer ENICAC (Electronic Numeral Integrator and Calculator) was launched at the University of Pennsylvania, This computer used thousands of vacuum tubes. UNIVAC (Universal Automatic Computer) was the first computer for handling both numeric and alphabetic data and it was also the first commercial computer.

The World Wide Web was unveiled in 1990, then many new graphical web browser programs came into use, in the coming years, the use of web and internet spurred the growth of general purpose home computing. This gave rise to more social interactions. Smartphones which incorporate a range of computer software with cellular telephones with touchscreen interface are now the demand of the hour.

Figure1.10: ENICAC (Electronic Numeral Integrator and Calculator)

1.4 Benefit of Computer System

1.4.1 Computer Systems-Definition

A computer is an electronic device. It consists of devices to enter data, process it, store it and give the results in the desired format. Data refers to raw facts and figures. Data is entered in the computer using an input device like a keyboard and is stored in the computer's memory. It is then processed as per the given set of instructions. The result is displayed on any of the output device such as monitor. The computer processes the data and produce information. Computers can only understand on and off electric signals, where ON means circuit is On and OFF means circuit is off (Binary signals).
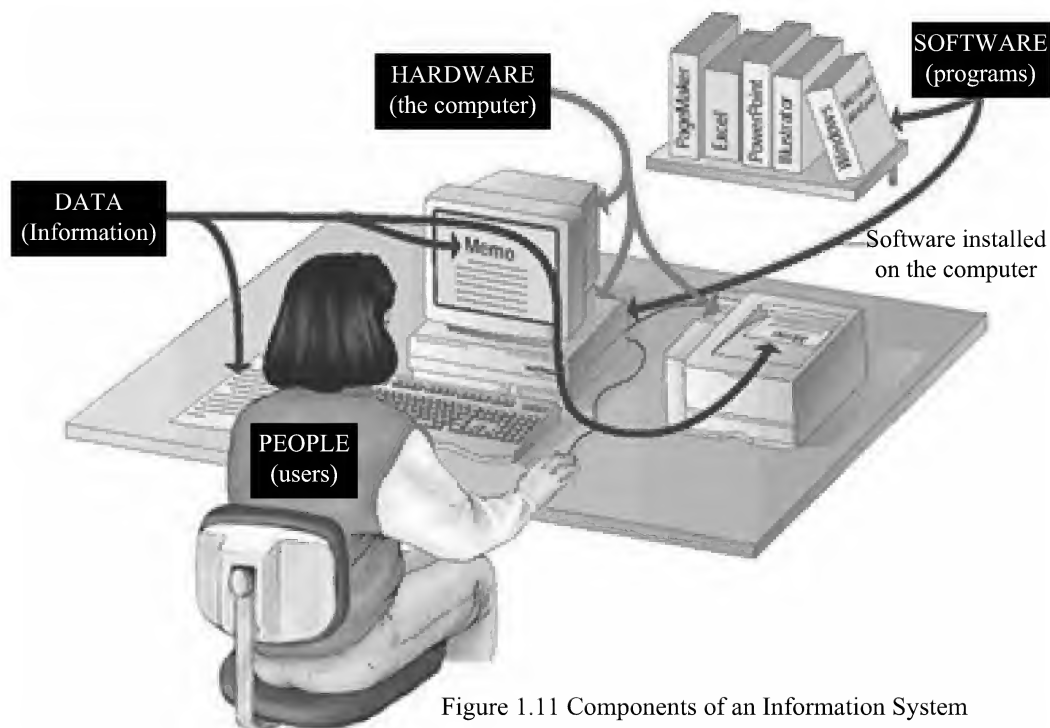

Figure 1.11 Components of an Information System

The way to think about a computer is as part of an information system. An **information system** has five parts: Data, Hardware, Software, Procedures, and Peoples.

➢ **People:** It is easy to oversee people as one of the essential parts of an information system. This is what computers are all about – making people, end users like us, more productive and effective.

➢ **Procedures:** The rules or guidelines for people to follow when using software, hardware and data are procedures. Computer Specialists document these procedures in manuals written by them.

➢ **Software:** A program consists of a set of instructions that tell the computer how to do its work step-by-step. Software is another name for a program or set of programs.

➢ **Hardware:** Hardware is controlled by software. The Hardware is the equipment's that process the data to create information. It includes the keyboard, mouse, monitor, system unit, and other devices.

➢ **Data:** The raw, unprocessed facts, including text, image, numbers and sounds are called data. Processed data yields information.

1.4.2   Basic Characteristics of Computer

1. **Speed**: The computer processes the data at a very high speed. Computers take only few seconds to process a huge amount of data, i.e. millions of instructions may be processed in a second.

2. **Accuracy:** The results produced by a computer are very correct. If correct data is entered in the computer, the output obtained is accurate. The computer works on the theory of GIGO (Garbage in Garbage out).

3. **High Storage Capacity:** Computers have a large memory and can store a large amount of data in a very compact manner. Any information stored in a computer may be retained in it for a very long period. With this feature, lot of repetition is avoided.

4. **Versatility:** Computers are used to perform a variety of tasks. We may use them to write letters prepare sheets, listen to music; prepare inventory reports, hospital management, banking and many more.

5. **Diligence:** Being a machine, a computer is free from fatigue, lack of concentration, boredom. Computer will perform the last instruction at the same speed at which the first instruction was processed.

Limitations: Computer is a dumb machine and it cannot do anything on its own. The Computer is an electronic device which is capable of receiving information (data) in a particular form and of performing a sequence of operations in accordance with a predetermined but variable set of procedural instructions (program) to produce a result in the form of information or signals. In an unanticipated situation, the computer cannot take any decision on its own. The sequence of instructions cannot be changed by the computer. It has no IQ (Intelligent Quotient).

1.5   Hardware & Software

1.5.1   Software

We perform different types of tasks with the help of computers. Actually all the processing is done with the help of software's which are stored in any of secondary memory device. Software is another name of programs. Software is collection of programs written for the purpose. A program is nothing but set of instructions written in a particular Programming Language. There are two major types of software: **System Software** and **Application Software**.
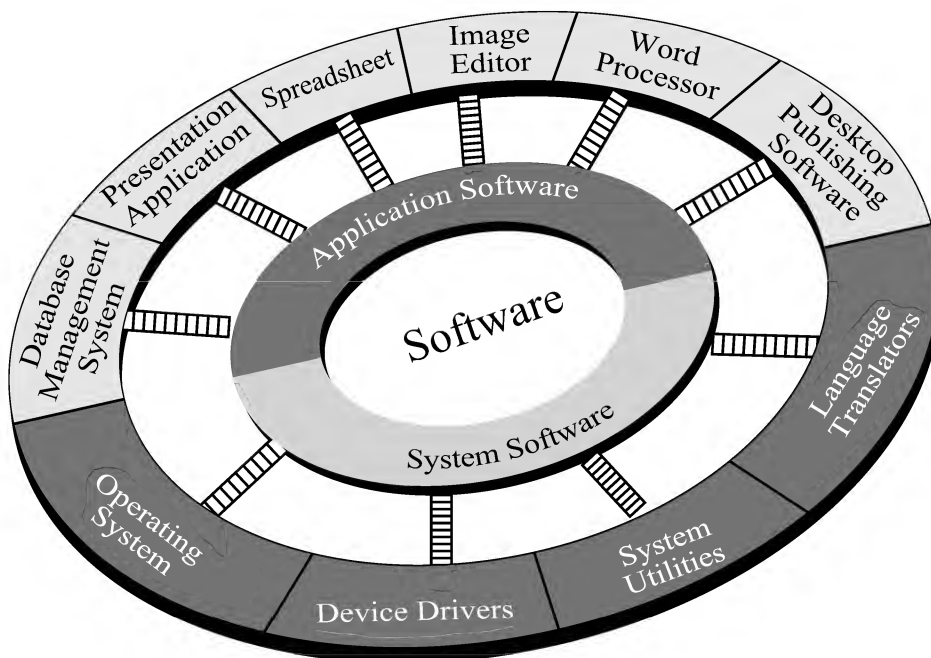
Figure: 1.12 Software Types

1.5.1.1 System Software

The system software is software by which a user interacts first, and then he works with application software. System software supports the computer to manage its internal resources; System program is not a single program but is a collection of many programs. Some of the important components of system programs are:

- **Operating System (OS):**An operating system (OS) is system software that manages computer hardware and software resources (CPU, Memory, Input and Output etc.) and provides common services for computer programs. It provides an interface between the computer and the user. Windows OS is the most widely used operating system on computers. Linux and Unix OS are also used in some specialised types of applications. They are of many types like real time, embedded, distributed etc.

- **Utilities:** The utilities are also provided by the operating systems. Utilities are used to enhance the computer resources like the utility disk defragmenter locates and removes undesirable file fragments and reorganizes disk space and files to improve computer operations.

- **Device drivers:** These are specialised programs which allow other input and output devices to communicate with the rest of the computer system.

- **Servers:** This is required to run different programs as per the requests received from different users.

SYSTEM SOFTWARE		APPLICATION SOFTWARE
Enable the computer to function	Usage	Enable user to work effiently with documentation
COMPULSORY	Need	OPTIONAL-depends on usage and needs
Each computer need one system system software	Number Software	Each computer can have more than one application
Independent - can use without application software	Dependency	Dependent - application software cannot work without system software
Provide environment in which the application run	Function	Provides the environment to enable user to accomplish specific task

Table 1.1 Application and System Software

1.5.1.2 Application Software

Application Softwares are the Softwares which are specially designed for the users(also called end-user programs); include such things as database programs, word processors, Web browsers and spreadsheets.

Basic Applications: These applications are widely used in almost all spheres of life like:

- Business
- Education
- Medical Sciences
- Banking
- Industries

This software also allows the user to complete jobs such as creating databases, documents, doing online shopping, spreadsheets, playing games, sending some messages. The application programs are designed in such a manner that the user finds it very friendly while working on them. For example, when a user is creating any word document file, he/she finds that the margins, line spacing, font size etc. are already been set. The user may add color, headings, and pictures to the document and may make it as required by him / her.

Example: - A web Browser is application software specially designed to locate, retrieve and display content found on the internet.

Browsers names: Mozilla Firefox, Safari, Google Chrome and Internet Explorer.

Specialized Applications include a number of other programs that are more closely concentrated on specific disciplines and jobs. Some of the best known are multimedia, graphics, video, audio, Web authoring, and Artificial Intelligence (A.I.) programs.

USEFUL TIP

A software suite is a group of software applications with related functionality. For example office software suites might include word processing, spreadsheet, database, presentation and email applications. There are other suites also like graphics suites for graphics work and audio master suite for audio production.

QUICK REVIEW

➤ Name few application software
➤ What is a web browser?
➤ What is a linker and what is does to a program?

1.5.2 Hardware

Hardware is a generic term used to define any component of a computer system with a physical presence and which can be seen and touched.

Common Hardware includes the monitor, computer case, keyboard, printers, electronic circuitry, memory chips, motherboard, expansion cards, cables, switches and everything you can touch and feel. Hardware components are often categorised as being **input**, **output, storage or processing** devices.

Devices which are not an essential part of the CPU are referred to as being peripherals. Peripheral

Devices are usually used for **input**, **output or storage** (such as a hard disk, keyboard or printer).

Input devices are hardware devices which take information from the user, convert it into electrical signals and transmit it to the processor. The key function of input devices is to allow humans to act together with the computer system. For instance a mouse permits the user to control the movement of the pointer on screen (a common element in user interface design).

Output devices take data from the computer system and convert it to a form that can be understood by humans. For instance a monitor produces a visual electronic display to output information created by the processor to the user.

Processing devices are the components accountable for the processing of information within the computer system. These include devices such as the Motherboard, CPU and Memory.

Storage devices are components which permit data to be stored within a computer system. This includes devices such as Compact Disk drives and hard disk drives.

Type of Components	Examples
Input	Trackball, Touchpad, Microphone, Keyboard, Sensors, Mouse, Joystick, Scanner , Web Cam
Processing	Motherboard, Processor (CPU), Memory
Output	Monitor, Printer, Headphone, Speaker, Touchscreen, Projectors etc.
Storage	Hard Disk Drive

Table 1.2 Summary of Hardware Types

Multiple Choice Questions

1. Name of High Level Language Introduced in Second Generation

   a. FORTRAN IV, PASCAL, BASIC

   b. C/C++

   c. COBOL and FORTRAN

   d. None of the above

2. Key component of first generation computer was

   a. Transistors

   b. Vacuum Tubes and Valves

   c. Integrated Circuits

   d. None of above

3. Second Generation computers were developed during

   a. 1949 to 1955   b. 1956 to 1965

   c. 1965 to 1970   d. 1970 to 1990

4. In which computer generation Microprocessor was introduced?

   a. First Generation

   b. Second Generation

   c. third Generation

   d. Fourth Generation

5. Which is not application software?

   a. Windows 7   b. Page Maker

   c. Notepad   d. Photoshop

6. Which of the following runs on computer hardware and serves as a platform for other Softwares to run on?

   a. Operating System

   b. Application Software

   c. A and B

   d. None of the above

7. ENIAC stands for:

   a. Electronic Networks Integrated Ace Computer

   b. Electronic Numerical Integration and Calculation

   c. Electronic Numerical Integrator&Computer

   d. Electronic November Is A Crossing

8. Raw facts such as letters, words and sounds are called:-

   a. Data   b. User Response

   c. Programs   d. Commands

9. An example of an Output device is a

   a. Scanner   b. Plotter

   c. Tapes   d. Software

10. Limitations of Computer System

    a. Speed   b. Accuracy

    c. Diligence   d. No IQ